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Huntsville Operations Support Center (HOSC)

Telescience Resource Kit (TReK)

Requirements Document

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Huntsville Operations Support Center (HOSC)

Telescience Resource Kit (TReK)

Requirements Document

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1 Introduction

The Telescience Resource Kit (TReK) is one of the Enhanced Huntsville Operations Support Center (HOSC) System (EHS) Remote Operations configuration options. This option is suitable for small experiment teams or individuals. TReK consists of a low-end workstation, such as a Personal Computer (PC), configured with a recommended combination of Commercial Off-the-Shelf (COTS) software and HOSC-provided interface software to provide the same basic functions as an EHS workstation. COTS includes licensed commercial software, shareware, and freeware. Capabilities provided by TReK include the capability to view telemetry, perform local exception monitoring, local calculations, word processing, file management, local command and control (including a scripting capability), and a local database. Information needed for the database can be downloaded from the supporting facility. Mission execution and mission planning tools will also be included as part of the TReK system. TReK capabilities can be extended by an end user by adding COTS products using the TReK Application Programming Interface (API). In addition, the workstation can interface directly with a Suitcase Test Environment for Payloads (STEP) or Suitcase Simulator system for flight tools checkout. TReK users are responsible for system configuration, system management, and security.

1.1 Purpose

This TReK requirements document has been organized with a specific implementation approach in mind based on the TReK project concept. A key part of the concept defines TReK as a COTS based system. Many requirements will be met by identifying a commercial product, and providing an interface to the product. Complete specifications for COTS products have not been developed. Instead, detailed capabilities provided through Enhanced HOSC System user applications will be used as the guideline for selecting commercial products. For example, a TReK user should assume that the commercial product selected to cover data display requirements will provide functionality similar to that found in the EHS Display Services applications. One should not assume that it will be possible to find a commercial product that provides an identical set of capabilities with regard to EHS applications. However, the goal is to match the functional capabilities as closely as possible. For these reasons, the TReK requirements document contains language such as "The TReK COTS product shall...". The intent is to identify within the TReK requirements document which requirements will be met with a commercial product.

Within many of the document's sections, there are references to the Enhanced HOSC System (EHS) Remote Operations Concept, HOSC-EHS-168. The Remote Operations Concept is the parent document for this document, since it contains the overall remote operations concept, and specifically the TReK project concept. Please note that TReK was previously named RUWS (Remote User Workstation). Therefore, when reviewing the Remote Operations Concept, please reference RUWS when looking for TReK information. References to the Remote Operations Concept have been provided to help

correlate information defined in the concept with the requirements defined in this document.

1.2 Supporting Facilities

For most major functions including telemetry and commanding, a TReK system relies on a connection to a supporting facility. A supporting facility is defined as a facility running EHS software. A supporting facility provides access to telemetry data, copies of telemetry and command databases, and support for numerous commanding activities. Current supporting facilities include the Huntsville Operations Support Center (HOSC) and various Telescience Support Centers (TSCs). If a TReK system's supporting facility is the HOSC, all interaction will be with the HOSC. For example, all telemetry and command functions which require support will be handled exclusively by the HOSC. If a TReK system's supporting facility is a TSC, then the majority of interaction will be with the TSC, while a small amount of interaction will take place with the HOSC. In particular, for a small number of commanding services, a TReK system supported by a TSC can interface with both the TSC and the HOSC. When a TSC supported user uplinks a command, the command is routed through the TSC and then to the HOSC. But a HOSC supported user's command is routed directly to the HOSC. For this reason, a TSC supported user may want to request command delog information from both the HOSC and the TSC. Both the HOSC and the TSC will maintain command delog information, and a TReK user supported by a TSC can request a copy of the information contained in either facility. This is because there may be additional information in the HOSC log that is not contained in the TSC log. HOSC supported users can only retrieve command delog information from the HOSC. The term "supporting facility" is used throughout this document to denote either the HOSC or a TSC. However, when necessary, some requirements call out the HOSC or TSC specifically in order to clearly identify a source of information for a particular service.

1.3 TReK Interfaces

Detailed information about interfaces between TREK and a supporting facility (EHS) will be defined in the HOSC to Generic User Interface Definition Document (IDD) HOSC-SYS-2237. Appendix D, located at the end of this document, provides a cross-reference between the interfaces referred to in this requirements document and the interface definitions provided in HOSC-SYS-2237. Information about interfaces between TReK and STEP/Suitcase Simulator systems will be defined in a TBD Interface Control Document (ICD).

1.4 Goals

There are several goals associated with the TReK project that are difficult to represent as requirements. In order to preserve these ideas, they have been included in this document as goals.

1. The primary goal of the TReK project, is to provide an inexpensive telemetry and command workstation option to remote users. The target goal is to keep the total cost under $10,000 in FY96 dollars.

2. Where possible, TReK is to utilize commercial products in lieu of developing new software.

3. TReK software will be developed with software portability in mind. The Win32 API has been targeted as a goal for maintaining software portability.

1.5 Applicable Documents

HOSC-EHS-168	Enhanced HOSC System (EHS) Remote Operations Concept
HOSC-DOC-188	Huntsville Operations Support Center (HOSC) Capabilities Document
HOSC-SYS-2237	HOSC to Generic User Interface Definition Document (IDD)
MSFC-DOC-1949	Marshall Space Flight Center (MSFC) HOSC Telemetry and Command Database Definition Document
MSFC-STD-1274B	MSFC HOSC Telemetry Format Standard
MSFC-STD-2535	MSFC HOSC Command Format Standard

2 Assumptions

There are several assumptions that have been made about the TReK project and the TReK environment. These assumptions have been included in this document so this information is available to potential TReK users.

1. TReK users will be responsible for purchasing and configuring TReK hardware based on Mission Operations Laboratory (MOL) recommendations.

2. TReK users will be responsible for purchasing, installing, and configuring any recommended commercial software products.

3. TReK users are responsible for system management, system configuration, and system security.

4. TReK users will be responsible for communicating directly with vendors for training associated with commercial products.

5. TReK users will be responsible for communicating directly with vendors about any issues associated with product functionality for commercial products identified for use with TReK.

6. TReK does not support hazardous commands.

7. The TReK Computations capability will not support updating external pseudos stored at the supporting facility. (See Section 3.4 Computations.)

8. TReK Computations are not compatible with EHS computations software. (See Section 3.4 Computations)

9. TReK Scripts will not support updating external pseudos stored at the supporting facility. (See Section 3.5 Scripting.)

10. TReK scripts are not compatible with EHS scripting software. (See Section 3.5 Scripting)

11. Database files from the Supporting Facility will be used to populate local TReK databases. (See Section 3.10 Database)

12. A TReK user can make modifications to the data in the local TReK databases at the user's own risk. (See Section 3.10 Database)

13. Reconfiguration changes (such as re-loading a database) will not be made automatically, they will require user intervention.

14. TReK users are responsible for ensuring that commands are not sent based on information from playback telemetry data vs real-time telemetry data. There will be no software constraints placed within TReK flight tools, such as scripts, to prevent a user from evaluating playback data to determine whether or not to uplink a command.

3 Requirements

3.1 General

This section addresses general requirements associated with system software, hardware, and system installation and configuration.

1. TReK shall provide the capability to perform the following functions independent of each other on the TReK platform:
    a. Telemetry
    b. Telemetry & Commanding
    c. Payload Information Management System (PIMS)
    d. Payload Planning System (PPS)

2. TReK shall include installation software.

3. TReK software shall be designed to operate on a multi-tasking operating system (Windows NT).

4. TReK software shall be designed to operate with a monitor configurable for a resolution of 1024 X 768 pixels.

5. TReK software shall be designed to operate with either of the following network interfaces:
    a. Fiber Distributed Data Interface (FDDI) network interface
    b. Ethernet network interface

6. TReK shall only support one of the following network interfaces at a time:
    a. FDDI network interface
    b. Ethernet network interface

7. TReK software shall not impose artificial limits on the data ingest rate.

Note: Data ingest rate will be determined by hardware not software.

3.2 Telemetry

TReK will request, receive, and process telemetry data. This section covers the following capabilities defined in the Remote Operations Concept: HOSC packet acquisition, decom telemetry, convert telemetry, calibrate telemetry, limit sense telemetry, modify local support data, and custom data packets.

1. TReK shall provide the capability to request Custom Data Packets as defined in HOSC-SYS-2237.

2. TReK shall process Custom Data Packets that adhere to the protocol defined in HOSC-SYS-2237.

3. TReK shall receive and process the primary and secondary EHS headers for PDSS telemetry packets that adhere to the protocol defined in HOSC-SYS-2237.

4. TReK shall make the data portion of a PDSS telemetry packet available to user applications.

5. TReK shall receive and process Consultative Committee for Space Data Systems (CCSDS) packets that adhere to protocols defined in the following documents:
   a. HOSC-SYS-2237
   b. MSFC-STD-1274B, Vol. 2

6. TReK shall provide a mechanism to share internal pseudo telemetry values between local TReK applications.

7. TReK shall convert telemetry data received through Custom Data Packets to standard data types compatible with TReK applications and hardware.

8. TReK shall provide the capability to modify conversion, calibration, and limit/expected state sensing information utilized by the supporting facility for custom data packets.

9. TReK shall provide the capability to modify local conversion, calibration, and limit/expected state sensing information used in conjunction with local CCSDS packet processing.

10. TReK shall support the following EHS telemetry data modes:
   a. Real-time
   b. Dump
   c. Playback

3.3 Data Display

This section covers the "View Telemetry" capability defined in the Remote Operations Concept. It is anticipated that a COTS product will be utilized to meet the requirements listed in this section. The EHS applications used as guidelines for determining the functionality that should be provided by the COTS product selected include Display Generation and Display Operation.

1. The TReK Data Display COTS product shall provide the capability to create, edit, save, and print displays used to view telemetry data.

2. The TReK Data Display COTS product shall provide the capability to view telemetry data in any of the following formats:
   a. textually
   b. graphically

3. The TReK Data Display COTS product shall provide the capability to set cyclic update rates when viewing telemetry data.

4. The TReK Data Display COTS product shall provide the capability to pause and restart a cyclic display.

5. The TReK Data Display COTS product shall provide the capability to modify attributes associated with how data values are displayed.

6. The TReK Data Display COTS product shall provide the capability to alert the user when a data value goes out of a specified range.

7. TReK shall include an interface between TReK telemetry processing capabilities and the TReK Data Display COTS product to handle displaying telemetry data from the following sources:

a. Custom Data Packets
b. CCSDS Packets
c. Local Pseudo Telemetry Data

8. The TReK Data Display COTS product shall provide the capability to display status characters for telemetry.

3.4 Computations

The requirements in this section correspond to the capability called "Individual Calculations" in the Remote Operations Concept. A computation refers to a software program which is to be compiled into executable code. The computations capability will be met by the requirements in this section and additional requirements defined in the Application Programming Interface section. It is anticipated that a COTS product will be identified to meet all the requirements in this section. The EHS applications used as guidelines for determining the functionality that should be provided by the COTS product selected include Computation Generation and Computation Operation.

1. The TReK Computations COTS product shall provide the capability to create, edit, save, and print computations.

2. The TReK Computations COTS product shall provide the capability to define C programs.

3. The TReK Computations COTS product shall provide the capability to define C++ programs.

4. TReK shall include an interface between TReK telemetry processing capabilities and the TReK Computations COTS product for inputs associated with telemetry data from the following sources:

a. Custom Data Packets
b. CCSDS Packets

c. Local Pseudo Telemetry Data.

5. TReK shall include an interface between TReK telemetry processing capabilities and the TReK Computations COTS product for outputs associated with internal pseudo telemetry data.

3.5 Scripting

The requirements in this section correspond to the capability called "Automated Procedures" in the Remote Operations Concept. An automated procedure or script refers to a software program which is to be interpreted. The automated procedures capability will be met by the requirements in this section and additional requirements defined in the Application Programming Interface section. It is anticipated that a COTS product will be identified to meet all the requirements in this section. The EHS applications used as guidelines for determining the functionality that should be provided by the COTS product selected include Script Generation and Script Operation. The term "Scripting" is used instead of the term "Automated Procedure" to avoid confusion with Timeliner automated procedures.

1. The TReK Scripting COTS product shall provide the capability to create, edit, save, and print automated procedures.

2. TReK shall include an interface between TReK telemetry processing capabilities and the TReK Scripting COTS product for inputs associated with telemetry data from the following sources:

a. Custom Data Packets
b. CCSDS Packets
c. Local Pseudo Telemetry Data.

3. TReK shall include an interface between TReK telemetry processing capabilities and the TReK Scripting COTS product for outputs associated with internal pseudo telemetry data.

4. TReK shall include an interface between TReK command processing capabilities and the TReK Scripting COTS product for inputs associated with commanding functions.

5. TReK shall include an interface between TReK command processing capabilities and the TReK Scripting COTS product for outputs associated with commanding functions.

3.6 Exception Monitoring

Exception Monitoring refers to the capability to define and view advisory messages that are generated when a telemetry value is out of range. It is anticipated that this capability will be met with the same COTS product identified to meet Data Display requirements. The following requirements correspond to the "Individual Exception Monitoring"

capability described in the Remote Operations Concept. Also included are capabilities for receiving "Multi-user exception monitoring" messages discussed in the concept. The TReK capabilities provided for exception monitoring are limited compared to those provided in the EHS Exception Monitoring application.

1. TReK shall receive and process Exception Monitoring messages from the supporting facility.

2. The TReK Exception Monitoring COTS product shall provide the capability to define exception monitoring messages for local telemetry values received by TReK.

3. The TReK Exception Monitoring COTS product shall provide the capability to define exception monitoring messages for internal pseudo telemetry values generated on TReK.

4. The TReK Exception Monitoring COTS product shall provide the capability to view local exception monitoring messages.

5. The TReK Exception Monitoring COTS product shall provide the capability to view multi-user exception monitoring messages output from the supporting facility.

3.7 Near Real Time (NRT) Requests

NRT Requests refers to the capability to request Near Real Time data that has been stored in the supporting facility's Near Real Time Data Log. The following requirements correspond to the "Stored Parameter Distribution" capability described in the Remote Operations Concept. These requirements are very similar to the capabilities provided within the following EHS applications: NRT List Request, NRT Snapshot Request, NRT Data Capture Request, and NRT Playback Request.

1. TReK shall provide the capability to create, edit, save, and submit a NRT List Request that meets the interface defined in HOSC-SYS-2237.

2. TReK shall provide the capability to create, edit, save, and submit a NRT Snapshot Request that meets the interface defined in HOSC-SYS-2237.

3. TReK shall provide the capability to create, edit, save, and submit a NRT Data Capture Request that meets the interface defined in HOSC-SYS-2237.

4. TReK shall provide the capability to create, edit, save, and submit a NRT Playback Request that meets the interface defined in HOSC-SYS-2237.

5. TReK shall provide the capability to create, edit, and submit a NRT Directory Request that meets the interface defined in HOSC-SYS-2237.

6. TReK shall receive NRT Output data returned as a result of any of the following NRT Requests:

a. NRT List Request
b. NRT Snapshot Request
c. NRT Data Capture Request
d. NRT Directory Request

Note: Data returned as a result of a NRT Playback Request is processed as telemetry data and is covered in Section 3.2 Telemetry.

3.8 NRT Data Analysis

NRT data analysis refers to the capability to view and analyze NRT data returned from a NRT List Request or a NRT Snapshot Request. It is anticipated that a COTS product will be identified to meet all the requirements in this section. Specifically, the Spreadsheet COTS product could be used to satisfy these requirements.

1. The TReK NRT Data Analysis COTS product shall be capable of accepting as input NRT data formatted as defined in HOSC-SYS-2237 to be viewed in a tabular (spreadsheet) format.

2. The TReK NRT Data Analysis COTS product shall be capable of accepting as input NRT data formatted as defined in HOSC-SYS-2237 to be viewed in a graphical format.

3.9 Commanding

This section covers the following capabilities defined in the Remote Operations Concept: command uplink, command responses, command update templates, command chain uplink, command file uplink, and command uplink history. For details about the format of a command, please see MSFC-STD-2535 MSFC HOSC Command Format Standard.

1. TReK shall provide the capability to view command configuration information from the supporting facility's Operational Command Database (OCDB).

2. TReK shall provide the capability to view command chain configuration information from the supporting facility's OCDB.

3. TReK shall provide the capability to view command file configuration information from the HOSC PIMS.

4. TReK shall provide the capability to view command header configuration information from the supporting facility's OCDB.

5. TReK shall provide the capability to view command attributes from a local TReK database.

6. TReK shall provide the capability to view command chain attributes from a local TReK database.

7. TReK shall provide the capability to view command file attributes from a local TReK database.

8. TReK shall provide the capability to view command header attributes from a local TReK database.

9. TReK shall provide the capability to add a predefined or modifiable tag to a reference command located in the local TReK database which corresponds to a reference command located in the supporting facility's OCDB.

10. TReK shall provide the capability to add new commands to the local TReK command database, by creating an alias for a reference command located in the local TReK database which corresponds to a reference command located in the supporting facility's OCDB.

11. TReK shall only support a command alias one level deep.

Note: When new commands are added they must be associated with a reference command directly, they cannot reference another alias.

12. TReK shall provide the capability to request, process, and submit the following types of command uplinks:

1. predefined command that resides in the supporting facility's OCDB
2. modifiable command that resides in the supporting facility's OCDB
3. command chain that resides in the supporting facility's OCDB.
4. reference command that resides in the local TReK database and is tagged as a predefined command.
5. reference command that resides in the local TReK database and is tagged as a modifiable command.
6. command file that resides in the HOSC PIMS.
7. local TReK command chain.

13. TReK shall output commands issued as part of a command chain in a contiguous manner.

Note: When the commands reach the HOSC, it is possible that other users commands may be interspersed with the commands that make up a command chain sent from a TReK system.

14. TReK shall wait until an EHS command response is received before sending the next command.

15. TReK shall provide the capability to modify the contents of a modifiable command located in the supporting facility's OCDB.

16. TReK shall provide the capability to modify the contents of a command chain located in the supporting facility's OCDB.

17. TReK shall provide the capability to modify the contents of a modifiable command located in a local TReK database.

18. TReK shall provide the capability to modify the contents of a command chain located in a local TReK database.

19. TReK shall provide the capability to submit a command file for storage in the HOSC PIMS database.

20. TReK shall provide the capability to receive and process command responses.

21. TReK shall provide the capability to view command responses.

22. TReK shall provide the capability to request and view command history information from the HOSC.

23. TReK shall provide the capability to request and view command history information from a TSC if the TReK system is serviced by a TSC.

24. TReK shall provide the capability to request and view a command delog report from the HOSC.

25. TReK shall provide the capability to request and view a command delog report from a TSC if the TReK system is serviced by a TSC.

26. TReK shall provide the capability to request and view command track information from the supporting facility (HOSC or TSC).

27. TReK shall provide the capability to request and view command system configuration information from the HOSC.

28. TReK shall provide the capability to request and view command system configuration information from a TSC if the TReK system is serviced by a TSC.

29. TReK shall provide the capability to view and modify local command data through command templates.

30. TReK shall provide the capability to view and modify supporting facility command data through command templates.

31. TReK shall provide the capability to submit a stop chain request to the supporting facility for a command chain uplink in progress executing in the supporting facility.

32. TReK shall provide the capability to submit a stop chain request for a command chain uplink in progress executing locally on the TReK machine.

33. TReK shall submit reference commands to the supporting facility for uplink in uplink format.

3.10 Database

This section covers the Selected Parameter Database capability defined in the Remote Operations Concept. It is anticipated that one or more COTS products will be utilized to meet the requirements listed in this section. These requirements are similar to the EHS Telemetry and Command database requirements. Please note that although a TReK user can make modifications to local TReK databases, the user must assume any risk associated with this activity.

1. TReK shall provide a local Telemetry Database capability that meets the following minimum requirements:
    a. provide screens to input, edit, and delete database data.
    b. host, at a minimum, the following telemetry data:
        1. Mnemonics and identifiers
        2. Descriptions
        3. Formats
        4. Engineering units
        5. Calibration/conversion data
        6. Limits/expected states
        7. Decomposition data
        8. Pseudo-parameters used in computational outputs
        9. Data Type
    c. provide a report capability
    d. import tables as defined in MSFC-DOC-1949 that are applicable to the TReK project.
    e. accept as input bulk downloads from an EHS database that adheres to MSFC-DOC-1949

2. TReK shall provide a local Command Database capability that meets the following minimum requirements:
    a. provide screens to input, edit, and delete database data.
    b. host, at a minimum, the following command data:

1. Mnemonics and other identifiers
2. Descriptions
3. Formats
4. Command constraints and restrictions
5. Telemetry verification
6. Predefined command data
7. Modifiable command data
8. Decalibration data
9. Command chains
10. Command data set
11. Header Data
12. Input Data Type
13. Uplink Data Type

c. provide a report capability

d. import tables as defined in MSFC-DOC-1949 that are applicable to the TReK project.

e. accept as input bulk downloads from an EHS database that adheres to MSFC-DOC-1949

3. The TReK Database COTS product shall provide the capability to extend the local Telemetry Database by providing the ability to modify any of the database data.

4. The TReK Database COTS product shall provide the capability to extend the local Telemetry Database by providing the ability to modify the database structure.

5. The TReK Database COTS product shall provide the capability to extend the local Command Database by providing the ability to modify any of the database data.

6. The TReK Database COTS product shall provide the capability to extend the local Command Database by providing the ability to modify the database structure.

3.11 Utilities

This section covers the following capabilities defined in the Remote Operations Concept: File Management, Word Processor, Graphics, Spreadsheet, Print, Time Display, Process Monitoring, Electronic Mail, and Message Capability. This section also addresses File Transfer and X-Windows. Almost all requirements in this section will be met with COTS products. Requirements for file management, a system clock, printing, a centralized message service, and the capability to monitor local processes, are not listed below since they are covered by the Windows NT operating system.

1. A COTS product shall be identified to meet basic word processing capabilities.

2. A COTS product shall be identified to meet basic spreadsheet capabilities .

3. TReK shall provide a utility to display GMT.

4. A COTS product shall be identified to provide basic file transfer capabilities which adhere to the file transfer protocol.

5. An X-Windows COTS product shall be identified to provide access to applications on a HOSC machine, TSC machine, (or other machines) for additional capabilities. At a minimum, an X-Windows interface shall be provided for a TReK user to perform the following functions:

a. browse the supporting facility's Telemetry Database
b. browse the supporting facility's Command Database
c. submit a Database Change Request to the supporting facility
d. access PIMS functions.

Note: In the future, EHS Remote Operations services may be made available through a web interface, whereby the X-Windows interface referred to here may no longer be necessary.

6. A COTS product shall be identified to provide basic web browser capabilities.

7. TReK shall provide an Acquisition of Signal (AOS)/Loss of Signal (LOS) Prediction utility.

3.12 Application Programming Interface

1. The TReK API shall provide the capability to request and receive unprocessed, converted, and calibrated telemetry data samples.

2. The TReK API shall provide the capability to request and receive internal pseudo telemetry data stored on the local TReK system.

3. The TReK API shall provide the capability to update internal pseudo telemetry data stored on the local TReK system.

4. The TReK API shall provide the capability to receive EHS status characters for requested telemetry and pseudo telemetry data.

5. The TReK API shall provide the capability to output EHS status characters associated with telemetry and pseudo-telemetry data.

6. The TReK API shall provide the capability to submit a command uplink request to the supporting facility for a command mnemonic that resides in the supporting facility's OCDB.

7. The TReK API shall provide the capability to submit a command chain uplink request to the supporting facility for a command chain mnemonic that resides in the supporting facility's OCDB.

8. The TReK API shall provide the capability to submit a reference command uplink request to the supporting facility for a reference command mnemonic that exists in the supporting facility's OCDB.

9. The TReK API shall provide the capability to submit modifiable command data to the supporting facility for storage in the supporting facility's OCDB.

10. The TReK API shall provide the capability to submit command chain contents data to the supporting facility for storage in the supporting facility's OCDB.

11. The TReK API shall provide the capability to submit a command file to the HOSC for storage in the HOSC PIMS database.

12. The TReK API shall provide the capability to initiate uplink of a command file that resides in the HOSC PIMS database.

13. The TReK API shall provide the capability to update a command chain stored in the TReK command database.

14. The TReK API shall provide the capability to submit an uplink request to the supporting facility for a command chain stored in the TReK command database.

15. The TReK API shall provide the capability to submit a stop chain request to the supporting facility for a command chain uplink in progress executing in the supporting facility.

16. The TReK API shall provide the capability to submit a stop chain request for a command chain uplink in progress executing locally on the TReK machine.

3.13 TReK Checkout

TREK Checkout refers to several different types of checkout capabilities provided by a TReK system. This includes Standalone Checkout (training), Flight Tools Checkout, and Interface Testing Checkout. Standalone Checkout provides a way for the user to put the TReK system in a standalone training mode. The user can practice using TReK COTS products and can begin building and using TReK flight tools such as displays, computations, and scripts. The Flight Tools Checkout capability provides a way to checkout flight tools using real payload data. TReK will support an interface between a TReK system and a STEP/Suitcase Simulator system for receiving telemetry (CCSDS packets) and sending commands. This provides a way for an experimenter to checkout flight tools using payload hardware while it is still located in a ground based laboratory.

Interface Testing Checkout refers to the capability to configure a TReK system for an interface test with a supporting facility.

1. TReK shall provide a Standalone Checkout (training) capability.

2. TReK shall support an interface to the following types of systems to receive CCSDS telemetry packets and submit commands in support of Flight Tools Checkout:
   a. STEP
   b. Suitcase Simulator

3. TReK shall support an Ethernet Transmission Control Protocol (TCP) /Internet Protocol (IP) interface to the following types of systems used for Flight Tools Checkout:
   a. STEP
   b. Suitcase Simulator

4. TReK shall receive and process CCSDS packets that adhere to the protocol defined in MSFC-STD-1274B, Vol. 2 and are defined in the local TReK telemetry database in support of the Flight Tools Checkout capability.

Note: It is assumed that the user will download an EHS Telemetry Database around Launch - 11 months to populate the local TReK Telemetry Database. This database download should contain the CCSDS packet definition if the CCSDS packet is processed by an EHS system.

5. TReK shall receive and process the primary header of a non compliant MSFC-STD-1274B CCSDS packet and make the data portion of the packet available to user applications.

6. TReK shall provide the capability to output a command in uplink format that is defined in the local TReK Command Database in support of the Flight Tools Checkout capability.

7. TReK shall provide the capability for the user to configure the TReK system in support of Interface Testing Checkout with a supporting facility.

3.14 Security

1. The TReK operating system shall provide the capability to require a user name and password to gain access to a TReK system.

2. It shall be possible to configure a TReK system to meet AIS Level II.

3. TReK shall provide services to meet the security interface required between a TReK system and EHS, regardless of the location of the supporting facility that is hosting the EHS software.

3.15 Payload Planning System

The Payload Planning System provides the experimenter with the capability to receive resource distributions and to plan his/her operations within the resources allocated. It also provides the capability to generate the experimenter's segment of the payload activity timeline and to view mission planning data. The requirements of the Payload Planning System are to be determined (TBD). When these requirements are available, they will be integrated into this document and may also modify statements of other sections.

Appendix A Acronym List

AIS	Automated Information Security
API	Application Programming Interface
COTS	Commercial Off The Shelf
EHS	Enhanced HOSC System
FDDI	Fiber Distributed Data Interface
HOSC	Huntsville Operations Support Center
ICD	Interface Control Document
MSID	Measurement/Stimulus Identifier (MSID)
OCDB	Operational Command Database
PIMS	Payload Information Management System
STEP	Suitcase Test Environment for Payloads
TReK	Telescience Resource Kit
TSC	Telescience Support Center

Appendix B Glossary

Automated Procedure
An automated procedure or script is a software program that contains a set of English-like instructions called directives. An automated procedure or script is interpreted not compiled.

Calibration
Calibration is the transformation of a parameter to a desired scientific dimension (engineering unit) or a text state. Parameters may be calibrated by polynomial equation, point pair (linear segment) interpolation, or by mapping a value to a text state code.

Command
A complete, defined sequence of data which communicates information from a source, either ground based or flight system based, to a payload or spacecraft destination.

Command Attributes
Command attributes refer to static information about a command such as the mnemonic, technical name, whether its predefined or modifiable, etc.

Command Chain
A user defined set of commands that are to be initiated in a sequential order.

Command Configuration Information
Command Configuration Information refers to the status and configuration of an individual command. For instance, this would include information such as the last uplink time, whether the command is currently enabled or disabled, and whether the command is currently complete or incomplete.

Command Delog Report
A command delog report contains information about commands including time of uplink, identification of the user who issued the command, source of the command, the uplinked data structure (in hex), retransmission indicators, command response statuses, and the type of command (e.g., individual transmission, file, etc.) Command delog reports are normally generated for a specific time period.

Command History
A list of the commands which have been transmitted from the intermediate command processing facility to the spacecraft.

Command Mnemonic
A unique name applied to a command.

Command Responses
Command responses are messages that acknowledge the acceptance or non-acceptance of a command. Command responses are dependent upon spacecraft design and ground system command routing.

Command System Configuration Information
Command System Configuration Information refers to information about the status and configuration of the supporting facility's command system. Examples include whether the command system is enabled or disabled, whether remote commanding is enabled or disabled, and which remote users are enabled or disabled for commanding.

Command Track
Command Track provides real-time information about the most recent commanding activities. Specifically, command track includes a list of information for each command including the command mnemonic, the time the command was sent, and the command responses associated with the command.

Computation
A software program written in a conventional programming language such as C or C++. A computation is compiled.

Conversion
Conversion is the conversion of downlinked spacecraft data types to ground system platform data types. The MSFC HOSC Telemetry Format Standard, MSFC-STD-1274B identifies supported downlink data types.

COTS Product
COTS stands for Commercial Off The Shelf. In TReK terms COTS products include commercial products, shareware, and freeware.

Critical Command
A command whose initiation and execution could possibly cause damage to a payload or spacecraft and could impair the mission.

Decommutation (decom)
Extraction of a measurement or parameter from telemetry.

Enhanced HOSC System
The Enhanced HOSC System refers to the hardware and software systems hosted within the Huntsville Operations Support Center.

Exception Monitor (EM)
Continuous monitoring of one or more measurements for limit/expected state exceptions (violations). Violation notification is provided through a text message.

Expected State Sensing
Expected State Sensing is the detection of a parameter not being in its nominal state. This processing is a corollary of state code calibration where a parameter is mapped to a text state code. One of the state codes must be selected as the "expected state". Processing detects violation of this "expected state".

Flight Tools
See TReK Flight Tool

Hazardous Command
A command whose initiation and execution could pose a threat to human life or entire mission.

Huntsville Operations Support Center (HOSC)
The Huntsville Operations Support Center (HOSC) is a NASA ground control center located at Marshall Space Flight Center in Huntsville Alabama. The HOSC mission is to provide real-time and near real-time telemetry processing, command processing, and mission planning in support of pre-launch integration and checkout, simulation, training, and flight operations.

Limit Sensing
Limit Sensing is the detection of caution and warning conditions for a parameter. A separate high and low range may be defined for caution and warning conditions respectively.

Local Table
A subset of the telemetry database which includes conversion, calibration, and limit/expected state (ES) sensing information.

Measurement/Stimulus Identifier (MSID)
A unique measurement name given to a telemetry or pseudo-telemetry parameter.

Modifiable Command
Command whose values can be updated in real-time (e.g., setting a temperature)

Near Real Time Data
Near Real Time Data consists of telemetry and pseudo telemetry data that has been stored to disk on a central platform and is available per various request types.

Operational Command Database (OCDB)
A database containing information about commands that is used in support of real-time commanding activities.

Packet
Asynchronous data wrapped in a packet protocol. Consultative Committee on Space Data Systems (CCSDS) packets can be used for downlink telemetry by the spacecraft. The EHS encapsulates all telemetry data in a HOSC packet protocol layered on top of CCSDS for internal routing.

Payload Information Management System (PIMS)
The Payload Information Management System is a multi-project electronic information management system used for mission preparation and execution. The primary purpose of the PIMS is to provide centralized payload operations information management for controlling changes to payload experiments, and spacecraft support for the Advanced X-Ray Astrophysics Facility (AXAF).

Playback Data Mode
A data mode in which data that was previously logged is played back into the system again.

Predefined Command
Command whose values and length are fixed and configuration controlled.

Pseudo Telemetry (or pseudos)
Value that has been computed from downlinked telemetry or other computed parameters.

Real-Time Data Mode
A data mode which processes data as it is received by the data system.

Reference Command
Reference commands are submitted by remote users to a supporting facility in order to send the complete content of a command. Reference commands differ from predefined or modifiable commands because the command data for these types of commands is stored in the OCDB, while the command data for a reference command is not stored in the supporting facility's OCDB. When a predefined or modifiable command is submitted for uplink by a remote user, the data for the command is retrieved from the OCDB. When a reference command is submitted for uplink by a remote user, the data for the command must be sent with the request to uplink the command.

Script
A script is a software program that contains a set of English-like instructions called directives. A script is interpreted not compiled. The term "automated procedure" is often used interchangeably with the term "script".

Status Characters
Status characters are used to provide information about the status of a telemetry or pseudo telemetry data value. Status characters are one character long and can represent a variety of information about the data value including data not available (N), static data (S), undefined MSID (U), etc.

Supporting Facility
A supporting facility is defined as a facility running EHS software. A supporting facility provides access to telemetry data, copies of telemetry and command databases, and support for numerous commanding activities. Current supporting facilities include the Huntsville Operations Support Center (HOSC) and Telescience Support Centers (TSCs).

TDM Telemetry
Time-Division Multiplexed data that is constructed onboard the spacecraft in a minor frame/major frame format

TReK Flight Tool
Displays, Computations, and Scripts are considered TReK flight tools. The term "flight tool" is used to refer to a software entity developed by the user (such as a display), using one or more TReK software products.

Appendix C Remote Operations Concept To TReK Requirements Document Cross-Reference Table

Remote Operations Concept	TReK Requirements Document Section Number
HOSC Packet Acquisition	3.2 Telemetry
Decom, convert, calibrate and limit sense telemetry	3.2 Telemetry
Custom Data Packet	3.2 Telemetry
Modify Local Support Data	3.3 Data Display
Individual Calculations	3.4 Computations
Individual Exception Monitoring	3.6 Exception Monitoring
View Telemetry	3.3 Data Display
Automated Procedures	3.5 Scripting
File Management	3.11 Utilities
Word Processor	3.11 Utilities
Graphics	3.11 Utilities
Spreadsheet	3.11 Utilities
Print	3.11 Utilities
Time Display	3.11 Utilities
Process Monitoring	3.11 Utilities
Electronic Mail	3.11 Utilities
Message Capability	3.11 Utilities
API	3.12 Application Programming Interface
Payload Checkout	3.13 TReK Checkout
Command Uplink	3.9 Commanding
Command Responses	3.9 Commanding
Command Update Templates	3.9 Commanding
Command Chain Uplink	3.9 Commanding
Command Chain Update	3.9 Commanding
Command File Uplink	3.9 Commanding
Command Uplink History	3.9 Commanding
Database Access	3.10 Database
Database Populate	3.10 Database

Appendix D TReK To EHS Interfaces Cross-Reference Table

#	TReK Interface	HOSC-SYS-2237 Section Number
1	PDSS Packet	TBD
2	Custom Data Packet	TBD
3	EHS Exception Monitoring Messages	TBD
4	NRT List Request	TBD
5	NRT Snapshot Request	TBD
6	NRT Data Capture Request	TBD
7	NRT Directory Data Request	TBD
8	NRT Data Output File	TBD
9	NRT Playback Request	TBD
10	NRT Playback Status Request	TBD
11	Command Mnemonic Uplink Request	TBD
12	Command Chain Uplink Request	TBD
13	Command File Uplink Request	TBD
14	Command Responses	TBD
15	Modify Command Request	TBD
16	Modify Chain Request	TBD
17	Command Data Status Request	TBD
18	Command (Track) Status Request	TBD
19	Command History Request	TBD
20	Command Delog Request	TBD
21	Command File store in PIMS Request	TBD
22	Reference Command Uplink Request	TBD
23	Command System Status Request	TBD
24	Configure Command System Request	TBD
25	Command Content Request	TBD
26	Command Chain Content Request	TBD
27	Partial Database Copy Request	TBD
28	Individual Parameter Database Copy Request	TBD
29	X-Windows	TBD
30	Security	TBD
31	HOSC Configuration Information Request	TBD